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EXAMINER	
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ART UNIT	**PAPER NUMBER**
2645	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/926,556	ASAHARA ET AL.	
	Examiner	Art Unit	
	Matthew W. Genack	2645	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 February 2002*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 November 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *19 November 2001*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: *21 February 2002*.

DETAILED ACTION

Claim Objections

1. Claim 12 is objected to because of the following informalities: "divice" appears in line 1 of Claim 12. Examiner interprets the claim such that "divice" is replaced by 'device." Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-4 and 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atarius *et. al.*, U.S. Patent No. 6,606,363, in view of Kobayashi *et. al.*, U.S. Patent No. 5,751,703., further in view of Takeuchi, U.S. Patent No. 6,408,038.

Regarding Claim 1, Atarius *et. al.* discloses an automatic frequency control system that controls the frequency of a received radio signal by compensating the frequency offset of said received radio signal (Column 2 Lines 18-24). Furthermore, Atarius *et. al.* discloses a method and apparatus for estimating frequency offset by combining data symbols and pilot symbols (Abstract). The Doppler spread of the received signal is estimated by analyzing the variation of the radio channel using pilot symbols (Column 4 Lines 24-30, 41-45).

Atarius *et. al.* does not expressly disclose the use of signals adjacent to the main signal and the estimation of the frequency of the direct wave via the amount of distortion of said adjacent known signals.

Kobayashi *et. al.* discloses a TDMA energy dispersal method for a mobile digital communication system (Column 5 Lines 37-43). The use of adjacent burst signals of fixed duration and intervening gaps with fixed duration for a TDMA transmitted signal is disclosed (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)); this is accomplished by mixing a phase modulation signal with a chirp signal (Column 4 Lines 42-56, Fig. 1). The received signal is mixed with a chirp signal (Fig. 1), and the resulting signal (Fig. 2(f)) is frequency offset corrected with an automatic frequency control circuit (Column 5 Lines 32-36).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using burst signals adjacent to the main signal of interest and using the amount of distortion of these adjacent burst signals to estimate the amount of Doppler spread in the received signal.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of correcting Doppler spread in lowering the bit error rate in a digital transmission.

Neither Atarius *et. al.* nor Kobayashi *et. al.* expressly discloses the estimation of the frequency of the direct wave via the amount of distortion of the adjacent known burst signals.

Takeuchi discloses an apparatus designed to receive a radio signal comprised of digital data and a synchronous reference signal that is used by an automatic frequency control circuit inside the apparatus to obtain a value for the frequency error (Abstract, Column 6 Lines 47-50, Fig. 6). Multi-path effects are corrected (signals corresponding to reflected waves are removed) for by comparing the strengths of the direct wave signal and the reflected wave signals (Column 9 Lines 32-48).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* as modified Kobayashi *et. al.* by using known burst signals adjacent to the main signal of interest, and using the amount of distortion of these adjacent burst signals to estimate the frequency of the direct wave via the amount of distortion of said adjacent known burst signals.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of estimating the frequency of the direct wave in lowering the bit error rate in a digital transmission.

Regarding Claim 2, Atarius *et. al.* discloses an automatic frequency control system that controls the frequency of a received radio signal by compensating the frequency offset of said received radio signal (Column 2 Lines 18-24).

Atarius *et. al.* does not expressly disclose the use of TDMA and burst signals.

Kobayashi *et. al.* discloses the use of TDMA burst signals in predetermined time slots (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using known signals adjacent to the main signal of interest, and the estimation of the frequency of the direct wave and the center frequency of the Doppler spread via the amount of distortion of said adjacent known signals, and to use a TDMA burst signal synchronized with a predetermined time slot in the received radio signal.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

Regarding Claim 3, Atarius *et. al.* discloses that the Doppler spread of the received signal is estimated by analyzing the variation of the radio channel using pilot symbols (Column 4 Lines 24-30, 41-45).

Atarius *et. al.* does not expressly disclose the use of signals adjacent to the main signal and the estimation of the frequency of the direct wave via the amount of distortion of said adjacent known signals.

Kobayashi *et. al.* discloses a TDMA energy dispersal method for a mobile digital communication system (Column 5 Lines 37-43). The use of adjacent burst signals of fixed duration and intervening gaps with fixed duration for a TDMA transmitted signal is disclosed (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)); this is accomplished by mixing a phase modulation signal with a chirp signal

(Column 4 Lines 42-56, Fig. 1). The received signal is mixed with a chirp signal (Fig. 1), and the resulting signal (Fig. 2(f)) is frequency offset corrected with an automatic frequency control circuit (Column 5 Lines 32-36).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using burst signals adjacent to the main signal of interest and using the amount of distortion of these adjacent burst signals to estimate the amount of Doppler spread in the received signal.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of correcting Doppler spread in lowering the bit error rate in a digital transmission.

Neither Atarius *et. al.* nor Kobayashi *et. al.* expressly discloses the estimation of the frequency of the direct wave via the amount of distortion of the adjacent known burst signals.

Takeuchi discloses an apparatus designed to receive a radio signal comprised of digital data and a synchronous reference signal that is used by an automatic frequency control circuit inside the apparatus to obtain a value for the frequency error (Abstract, Column 6 Lines 47-50, Fig. 6). Multi-path effects are corrected (signals corresponding to reflected waves are removed) for by comparing the strengths of the direct wave signal and the reflected wave signals (Column 9 Lines 32-48).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of

Atarius *et. al.* as modified Kobayashi *et. al.* by using known burst signals adjacent to the main signal of interest, and using the amount of distortion of these adjacent burst signals to estimate the frequency of the direct wave via the amount of distortion of said adjacent known burst signals.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of estimating the frequency of the direct wave in lowering the bit error rate in a digital transmission.

Regarding Claim 4, Atarius *et. al.* discloses that the Doppler spread of the received signal is estimated by analyzing the variation of the radio channel using pilot symbols (Column 4 Lines 24-30, 41-45). Furthermore, it is disclosed that the phases of the pilot symbols and data symbols may be combined to estimate the frequency offset of the received radio signal (Column 4 Lines 16-18).

Atarius *et. al.* does not expressly disclose all of the limitations of Claim 3, upon which Claim 4 depends.

Kobayashi *et. al.* discloses a TDMA energy dispersal method for a mobile digital communication system (Column 5 Lines 37-43). The use of adjacent burst signals of fixed duration and intervening gaps with fixed duration for a TDMA transmitted signal is disclosed (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)); this is accomplished by mixing a phase modulation signal with a chirp signal (Column 4 Lines 42-56, Fig. 1). The received signal is mixed with a chirp signal (Fig. 1), and the resulting signal (Fig. 2(f)) is frequency offset corrected with an automatic frequency control circuit (Column 5 Lines 32-36).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using burst signals adjacent to the main signal of interest and using the amount of distortion of these adjacent burst signals to estimate the amount of Doppler spread in the received signal.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of correcting Doppler spread in lowering the bit error rate in a digital transmission.

Neither Atarius *et. al.* nor Kobayashi *et. al.* expressly discloses the estimation of the frequency of the direct wave via the amount of distortion of the adjacent known burst signals.

Takeuchi discloses an apparatus designed to receive a radio signal comprised of digital data and a synchronous reference signal that is used by an automatic frequency control circuit inside the apparatus to obtain a value for the frequency error (Abstract, Column 6 Lines 47-50, Fig. 6). Multi-path effects are corrected (signals corresponding to reflected waves are removed) for by comparing the strengths of the direct wave signal and the reflected wave signals (Column 9 Lines 32-48).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* as modified Kobayashi *et. al.* by using known burst signals adjacent to the main signal of interest, and using the amount of distortion of

these adjacent burst signals to estimate the frequency of the direct wave via the amount of distortion of said adjacent known burst signals.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of estimating the frequency of the direct wave in lowering the bit error rate in a digital transmission.

Regarding Claim 10, Atarius *et. al.*, Kobayashi *et. al.*, and Takeuchi disclose all of the limitations of Claim 3, as outlined above, upon which Claim 10 depends. Additionally, Takeuchi discloses the presence of a bandpass filter in the frontend circuitry of the radio receiver (Figs. 7-8).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using known signals adjacent to the main signal of interest, and the estimation of the frequency of the direct wave and the center frequency of the Doppler spread via the amount of distortion of said adjacent known signals, and the use of a bandpass filter in the frontend path for the elimination of high frequency components from the received radio signal.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

Regarding Claim 11, Atarius *et. al.* discloses an automatic frequency control system that controls the frequency of a received radio signal by compensating the frequency offset of said received radio signal (Column 2 Lines 18-24). Furthermore, Atarius *et. al.* discloses a method and apparatus for

estimating frequency offset by combining data symbols and pilot symbols (Abstract). The Doppler spread of the received signal is estimated by analyzing the variation of the radio channel using pilot symbols (Column 4 Lines 24-30, 41-45).

Atarius *et. al.* does not expressly disclose the use of signals adjacent to the main signal and the estimation of the frequency of the direct wave via the amount of distortion of said adjacent known signals.

Kobayashi *et. al.* discloses a TDMA energy dispersal method for a mobile digital communication system (Column 5 Lines 37-43). The use of adjacent burst signals of fixed duration and intervening gaps with fixed duration for a TDMA transmitted signal is disclosed (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)); this is accomplished by mixing a phase modulation signal with a chirp signal (Column 4 Lines 42-56, Fig. 1). The received signal is mixed with a chirp signal (Fig. 1), and the resulting signal (Fig. 2(f)) is frequency offset corrected with an automatic frequency control circuit (Column 5 Lines 32-36).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using burst signals adjacent to the main signal of interest and using the amount of distortion of these adjacent burst signals to estimate the amount of Doppler spread in the received signal.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of correcting Doppler spread in lowering the bit error rate in a digital transmission.

Neither Atarius *et. al.* nor Kobayashi *et. al.* expressly discloses the estimation of the frequency of the direct wave via the amount of distortion of the adjacent known burst signals.

Takeuchi discloses an apparatus designed to receive a radio signal comprised of digital data and a synchronous reference signal that is used by an automatic frequency control circuit inside the apparatus to obtain a value for the frequency error (Abstract, Column 6 Lines 47-50, Fig. 6). Multi-path effects are corrected (signals corresponding to reflected waves are removed) for by comparing the strengths of the direct wave signal and the reflected wave signals (Column 9 Lines 32-48).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* as modified Kobayashi *et. al.* by using known burst signals adjacent to the main signal of interest, and using the amount of distortion of these adjacent burst signals to estimate the frequency of the direct wave via the amount of distortion of said adjacent known burst signals.

One of ordinary skill in the art would have been motivated to make this modification because of the importance of estimating the frequency of the direct wave in lowering the bit error rate in a digital transmission.

4. Claims 5 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atarius *et. al.* in view of Kobayashi *et. al.*, further in view of Takeuchi, further in view of Brardjanian *et. al.*, U.S. Patent No. 6,590,945.

Regarding Claim 5, Atarius *et. al.*, Kobayashi *et. al.*, Takeuchi, disclose all of the limitations of Claims 3 and 4, as outlined above, upon which Claim 5 depends.

Neither Atarius *et. al.*, nor Kobayashi *et. al.*, nor Takeuchi, expressly disclose the averaging of the phase difference vectors between adjacent known signals.

Brardjanian *et. al.* discloses a method and apparatus for frequency offset compensation whereby phase angles are used to form comparison vectors, said comparison vectors are rotated, and said phase angles are averaged (Abstract). Brardjanian *et. al.* teaches that a conventional approach in frequency tracking is to average, over time, the phase difference between the received signal and a reference signal, and to use this value in making adjustments (Column 2 Lines 35-45).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* by using known signals adjacent to the main signal of interest, and the estimation of the frequency of the direct wave and the center frequency of the Doppler spread via the amount of distortion of said adjacent known signals, and the use of phase synthesis to synthesize the phases corresponding to the frequency of the direct wave and the center frequency of the Doppler spread so as to accomplish the estimation of the frequency offset of the received radio signal, and the estimation of the frequency of the direct wave by the

determination of the average phase difference vector between known adjacent signals.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

Regarding Claim 7, Atarius *et. al.,* Kobayashi *et. al.*, and Takeuchi disclose all of the limitations of Claims 3 and 4, as outlined above, upon which Claim 7 depends.

Neither Atarius *et. al.*, nor Kobayashi *et. al.*, nor Takeuchi expressly disclose the averaging of the phase difference vectors between adjacent known signals.

Brardjanian *et. al.* discloses a method and apparatus for frequency offset compensation whereby phase angles are used to form comparison vectors, said comparison vectors are rotated, and said phase angles are averaged (Abstract). Brardjanian *et. al.* teaches that a conventional approach in frequency tracking is to average, over time, the phase difference between the received signal and a reference signal, and to use this value in making adjustments (Column 2 Lines 35-45).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Uchiki *et. al.* by using known signals adjacent to the main signal of interest, and the estimation of the frequency of the direct wave and the center frequency of the Doppler spread via the amount of distortion of said adjacent known signals, and

the use of phase synthesis to synthesize the phases corresponding to the frequency of the direct wave and the center frequency of the Doppler spread so as to accomplish the estimation of the frequency offset of the received radio signal, and the estimation of the frequency of the direct wave by the determination of the average phase difference vector between known adjacent signals.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

5. Claims 6 and 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Atarius *et. al.* in view of Kobayashi *et. al.*, further in view of Takeuchi, further in view of Naden *et. al.*, U.S. Patent No. 5,999,561.

Regarding Claim 6, Atarius *et. al.*, Kobayashi *et. al.*, and Takeuchi disclose all of the limitations of Claims 3 and 4, as outlined above, upon which Claim 6 depends.

Neither Atarius *et. al.*, nor Kobayashi *et. al.*, nor Takeuchi expressly disclose the determination of the signal powers of frequency offset candidates within a predetermined estimation range based on the determined average distortion amount, nor the window signal power of all frequency offset candidates in the frequency window of predetermined width, nor do any estimate the frequency offset candidate corresponding to the maximum value of the determined window signal powers as the center frequency of the Doppler spread.

Naden *et. al.* discloses a method and apparatus that employ a digital receiver that receives, digitizes, and processes a spread spectrum signal (Abstract). Carrier frequency error which occurs in the wireless path between transmitter and receiver is removed with an automatic frequency control loop (Column 45 Lines 27-29). A frequency generator and phase shifting delay element generate the needed frequency offset, and after filtering, the power levels of the respective channels may be determined (Column 52 Lines 14-34). Signal power is computed by using squaring and summation functional blocks on sampled data (Column 20 Lines 23-33). After the down-conversion of the received analog spread spectrum signal to intermediate frequency, the intermediate frequency signal is sampled across its frequency range by a ADC (Column 16 Lines 41-50).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* as modified by Kobayashi *et. al.*, as further modified by Takeuchi, by providing means for the determination of the signal powers of frequency offset candidates within a predetermined estimation range based on the determined average distortion amount, the window signal power of all frequency offset candidates in the frequency window of predetermined width, and the estimatation the frequency offset candidate corresponding to the maximum value of the determined window signal powers as the center frequency of the Doppler spread.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

Regarding Claim 8, Atarius *et. al.*, Kobayashi *et. al.*, and Takeuchi disclose all of the limitations of Claims 3 and 4, as outlined above, upon which Claim 8 depends.

Neither Atarius *et. al.*, nor Kobayashi *et. al.*, nor Takeuchi expressly disclose the determination of the signal powers of frequency offset candidates within a predetermined estimation range based on the determined average distortion amount, nor the window signal power of all frequency offset candidates in the frequency window of predetermined width, nor do any estimate the frequency offset candidate corresponding to the maximum value of the determined window signal powers as the center frequency of the Doppler spread.

Naden *et. al.* discloses a method and apparatus that employ a digital receiver that receives, digitizes, and processes a spread spectrum signal (Abstract). Carrier frequency error which occurs in the wireless path between transmitter and receiver is removed with an automatic frequency control loop (Column 45 Lines 27-29). A frequency generator and phase shifting delay element generate the needed frequency offset, and after filtering, the power levels of the respective channels may be determined (Column 52 Lines 14-34). Signal power is computed by using squaring and summation functional blocks on sampled data (Column 20 Lines 23-33). After the down-conversion of the received analog spread spectrum signal to intermediate frequency, the

intermediate frequency signal is sampled across its frequency range by a ADC (Column 16 Lines 41-50).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* as modified by Kobayashi *et. al.*, as further modified by Takeuchi, by providing means for the determination of the signal powers of frequency offset candidates within a predetermined estimation range based on the determined average distortion amount, the window signal power of all frequency offset candidates in the frequency window of predetermined width, and the estimatation the frequency offset candidate corresponding to the maximum value of the determined window signal powers as the center frequency of the Doppler spread.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

Regarding Claim 9, Atarius *et. al.*, Kobayashi *et. al.*, and Takeuchi disclose all of the limitations of Claims 3 and 4, as outlined above, upon which Claim 9 depends.

Neither Atarius *et. al.*, nor Kobayashi *et. al.*, nor Takeuchi expressly disclose the determination of the signal powers of frequency offset candidates within a predetermined estimation range based on the determined average distortion amount, nor the window signal power of all frequency offset candidates in the frequency window of predetermined width, nor do any estimate the

frequency offset candidate corresponding to the maximum value of the determined window signal powers as the center frequency of the Doppler spread.

Naden *et. al.* discloses a method and apparatus that employ a digital receiver that receives, digitizes, and processes a spread spectrum signal (Abstract). Carrier frequency error which occurs in the wireless path between transmitter and receiver is removed with an automatic frequency control loop (Column 45 Lines 27-29). A frequency generator and phase shifting delay element generate the needed frequency offset, and after filtering, the power levels of the respective channels may be determined (Column 52 Lines 14-34). Signal power is computed by using squaring and summation functional blocks on sampled data (Column 20 Lines 23-33). After the down-conversion of the received analog spread spectrum signal to intermediate frequency, the intermediate frequency signal is sampled across its frequency range by a ADC (Column 16 Lines 41-50).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the automatic frequency control system of Atarius *et. al.* as modified by Kobayashi *et. al.*, as further modified by Takeuchi, by providing means for the determination of the signal powers of frequency offset candidates within a predetermined estimation range based on the determined average distortion amount, the window signal power of all frequency offset candidates in the frequency window of predetermined width, and the estimatation the frequency offset candidate corresponding to the maximum value of the determined window signal powers as the center frequency of the Doppler spread.

One of ordinary skill in the art would have been motivated to make this modification because of its aid in achieving a lower bit error rate inherent in a digital wireless communication system.

6. Claims 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Muto, U.S. Patent No. 5,630,218, in view of Kobayashi *et. al.*, further in view of Takeuchi, further in view of Atarius *et. al.*

Regarding Claim 12, Muto discloses a radio receiving circuit (Abstract). This circuit includes an A/D converter and a digital signal processor (Fig. 10). The frequency converter converts the received radio signal into a lower frequency analog signal, and a band-pass filter immediately downstream from the frequency converter filters a special frequency pertaining to the receiving device, along with adjacent channels above and below this frequency (Column 3 Lines 14-20). This down-converted analog signal is converted into a digital signal via an A/D converter (Column 3 Lines 20-21). The digital signal processor then demodulates these adjacent input signals (Column 3 Lines 21-24).

Muto does not expressly disclose the digital signal processor accomplishing the estimation of the frequency of the direct wave of the received radio signal and the center frequency of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal, nor the elimination of the frequency offset from the digital signal based on both aforementioned frequencies.

Kobayashi *et. al.* discloses a TDMA energy dispersal method for a mobile digital communication system (Column 5 Lines 37-43). The use of adjacent burst

signals of fixed duration and intervening gaps with fixed duration for a TDMA transmitted signal is disclosed (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)); this is accomplished by mixing a phase modulation signal with a chirp signal (Column 4 Lines 42-56, Fig. 1). The received signal is mixed with a chirp signal (Fig. 1), and the resulting signal (Fig. 2(f)) is frequency offset corrected with an automatic frequency control circuit (Column 5 Lines 32-36).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto by modifying the digital signal processor of that invention such that it eliminates the frequency offset from the digital signal.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

Neither Muto nor Kobayashi *et. al.* expressly disclose a digital signal processor accomplishing the estimation of the frequency of the direct wave of the received radio signal and the center frequency of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal.

Takeuchi discloses an apparatus designed to receive a radio signal comprised of digital data and a synchronous reference signal that is used by an automatic frequency control circuit inside the apparatus to obtain a value for the frequency error (Abstract, Column 6 Lines 47-50, Fig. 6). Multi-path effects are corrected (signals corresponding to reflected waves are removed) for by

comparing the strengths of the direct wave signal and the reflected wave signals (Column 9 Lines 32-48).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto as modified by Kobayashi *et. al.* by modifying the digital signal processor such that it estimates the frequency of the direct wave based on distortion amounts in the inputted digital signal.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

Neither Muto, nor Kobayashi *et. al.*, nor Takeuchi expressly disclose the estimation of the center frequency of the Doppler spread of the received radio signal.

Atarius *et. al.* discloses a method and apparatus for estimating frequency offset by combining data symbols and pilot symbols (Abstract). The Doppler spread of the received signal is estimated by analyzing the variation of the radio channel using pilot symbols (Column 4 Lines 24-30, 41-45).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto as modified by Kobayashi *et. al.* further modified by Takeuchi by modifying the digital signal processor of that invention such that it accomplishes the estimation of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

Regarding Claim 13, Muto discloses a radio receiving circuit (Abstract). This circuit includes an A/D converter and a digital signal processor (Fig. 10). The frequency converter converts the received radio signal into a lower frequency analog signal, and a band-pass filter immediately downstream from the frequency converter filters a special frequency pertaining to the receiving device, along with adjacent channels above and below this frequency (Column 3 Lines 14-20). This down-converted analog signal is converted into a digital signal via an A/D converter (Column 3 Lines 20-21). The digital signal processor then demodulates these adjacent input signals (Column 3 Lines 21-24).

Muto does not expressly disclose the digital signal processor accomplishing the estimation of the frequency of the direct wave of the received radio signal and the center frequency of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal, nor the elimination of the frequency offset from the digital signal based on both aforementioned frequencies.

Kobayashi *et. al.* discloses a TDMA energy dispersal method for a mobile digital communication system (Column 5 Lines 37-43). The use of adjacent burst signals of fixed duration and intervening gaps with fixed duration for a TDMA transmitted signal is disclosed (Column 4 Line 66 to Column 5 Line 3, Fig. 2(a)); this is accomplished by mixing a phase modulation signal with a chirp signal

(Column 4 Lines 42-56, Fig. 1). The received signal is mixed with a chirp signal (Fig. 1), and the resulting signal (Fig. 2(f)) is frequency offset corrected with an automatic frequency control circuit (Column 5 Lines 32-36).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto by modifying the digital signal processor of that invention such that it eliminates the frequency offset from the digital signal.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

Neither Muto nor Kobayashi *et. al.* expressly disclose a digital signal processor accomplishing the estimation of the frequency of the direct wave of the received radio signal and the center frequency of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal.

Takeuchi discloses an apparatus designed to receive a radio signal comprised of digital data and a synchronous reference signal that is used by an automatic frequency control circuit inside the apparatus to obtain a value for the frequency error (Abstract, Column 6 Lines 47-50, Fig. 6). Multi-path effects are corrected (signals corresponding to reflected waves are removed) for by comparing the strengths of the direct wave signal and the reflected wave signals (Column 9 Lines 32-48).

At the time that the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto as modified by

Kobayashi *et. al.* by modifying the digital signal processor such that it estimates the frequency of the direct wave based on distortion amounts in the inputted digital signal.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

Neither Muto, nor Kobayashi *et. al.*, nor Takeuchi expressly disclose the estimation of the center frequency of the Doppler spread of the received radio signal.

Atarius *et. al.* discloses a method and apparatus for estimating frequency offset by combining data symbols and pilot symbols (Abstract). The Doppler spread of the received signal is estimated by analyzing the variation of the radio channel using pilot symbols (Column 4 Lines 24-30, 41-45).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto as modified by Kobayashi *et. al.* further modified by Takeuchi by modifying the digital signal processor of that invention such that it accomplishes the estimation of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

7. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Muto in view of Kobayashi *et. al.*, further in view of Takeuchi, further in view of Atarius *et. al.*, further in view of Kumagai *et. al.*, U.S. Patent No. 5,548,811.

Muto, Kobayashi *et. al.*, Takeuchi, and Atarius *et. al.* disclose all of the limitations of Claim 13, upon which Claim 14 depends.

Neither Muto, nor Kobayashi *et. al.*, nor Takeuchi, nor Atarius *et. al.* expressly disclose the use of a VCO as part of a frequency converter.

Kumagai *et. al.* discloses the use of a voltage controlled oscillator with a frequency converter in the larger context of a automatic frequency control circuit (Column 4 Lines 56-61).

At the time the invention was made, it would have been obvious to one of ordinary skill in the art to modify the invention of Muto by modifying the digital signal processor of that invention such that it accomplishes the estimation of the frequency of the direct wave of the received radio signal and the center frequency of the Doppler spread of the received radio signal based on distortion amounts in the inputted digital signal, the elimination of the frequency offset from the digital signal based on both aforementioned frequencies, and the elimination of fading distortion from the digital signal, and furthermore including a voltage controlled oscillator with the frequency converter for the purpose of providing the proper frequency for mixing the received radio signal down to the desired frequency, so as to accomplish frequency offset elimination.

One of ordinary skill in the art would have been motivated to make this modification because such hardware would aid in achieving a lower bit error rate in a digital wireless communication system.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew W. Genack whose telephone number is 703-605-4305. The examiner can normally be reached on FLEX.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Fan Tsang can be reached on 703-305-4895. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew Genack

Examiner

Art Unit 2645

Matthew Genack

18 February 2005

OVIDIO ESCALANTE
PATENT EXAMINER

Ovidio Escalante